

2-channel driver for CD changers

BA6780 / BA6780FP-Y

The BA6780 and BA6780FP-Y are 2-channel driver IC for CD changers that includes a reversible, variable speed electronic governor and a reversible driver. On sets that have dual-rail power supplies, the BA6780 and BA6780FP-Y can be operated from just the negative supply to reduce influence on the positive power supply.

The input uses PWM control, and it is possible to directly input from a microprocessor running off the positive power supply.

●Applications

Changers for CD players and MD players.

●Features

- 1) Output voltage can be freely set using the output voltage setting pin.
- 2) Internal mute function if the power supply voltage drops.
- 3) Thermal shutdown function. (Contains hysteresis)
- 4) PWM input.
- 5) Settable reference voltage output pin.
- 6) Wide operating supply voltage.

●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V _{CC}	18	V
Logic input voltage	V _{FIN} , V _{RIN}	22	V
Power dissipation	BA6780	1.31 *1	W
	BA6780FP-Y	1.45 *2	
Maximum current consumption	I _{max}	1.4 *3	A
Operating temperature	T _{opr}	-25~+75	°C
Storage temperature	T _{stg}	-55~+150	°C

*1 When a DIP18 package is used.Reduced by 10.48mW for each increase inTa of 1°C over 25°C.

*2 When mounted on a PCB board (70mm×70mm, t=1.6mm glass epoxy board).

Reduced by 11.6mW for each increase in Ta of 1°C over 25°C.

*3 Should not exceed Pd or ASO values.

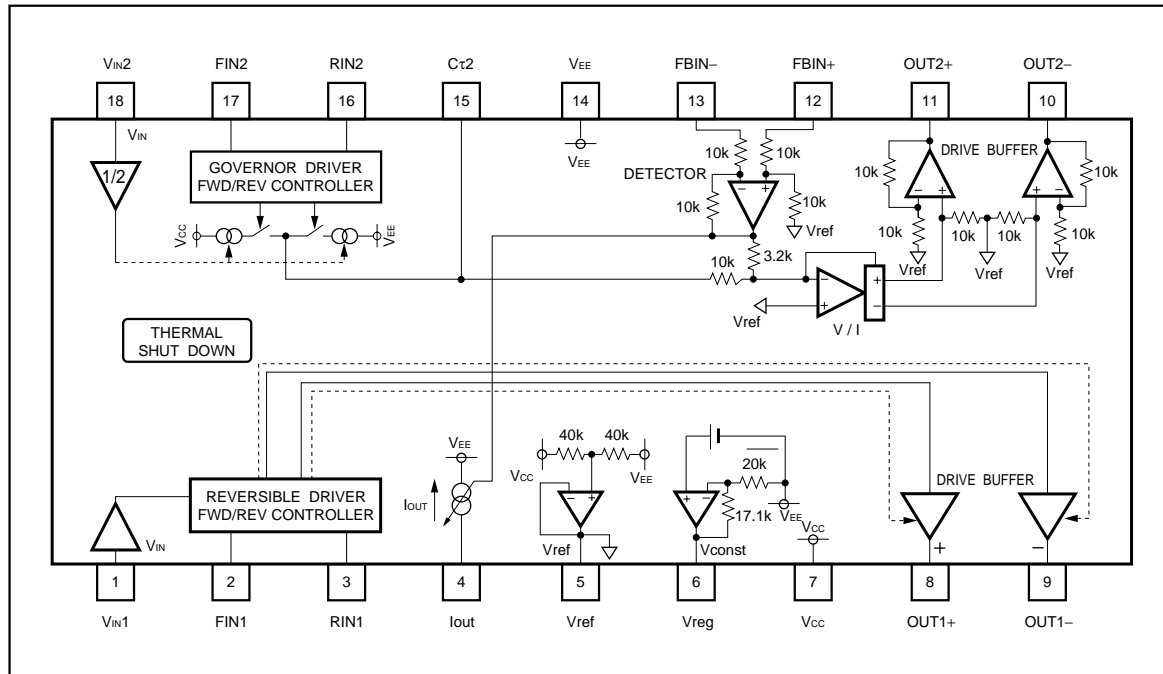
●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V _{CC}	7~16	V
Input voltage for Vin	V _{IN}	0~V _{CC} / 2~1.0	V

Optical disc ICs

●Block diagram and pin descriptions

BA6780

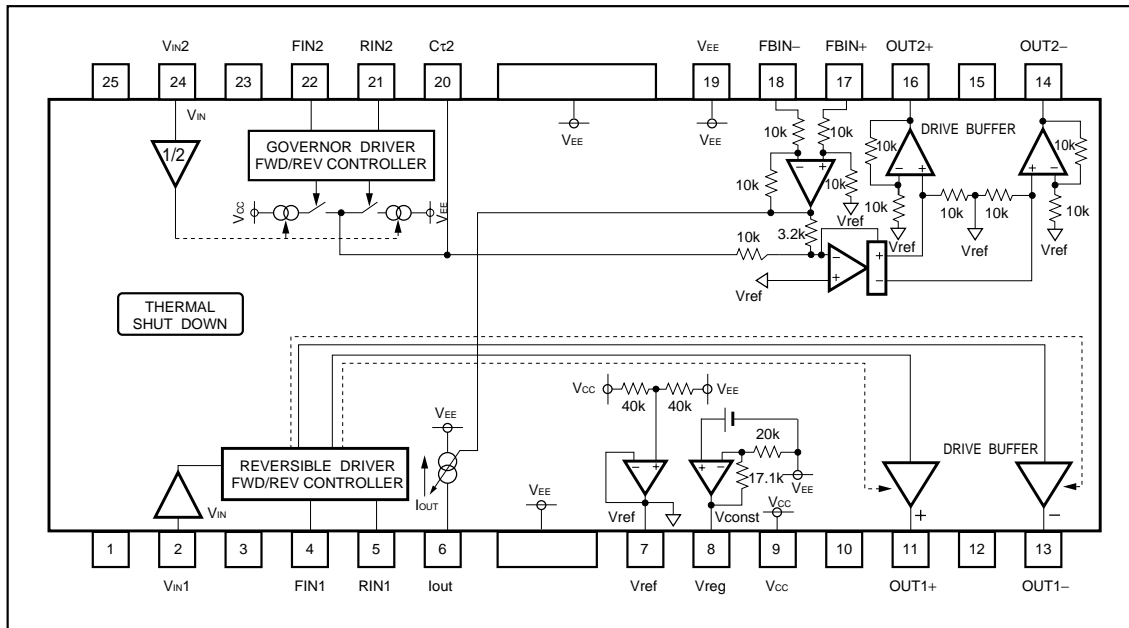


Pin No.	Pin name	I/O	Function
1	V _{IN1}	I	Input pin for setting high output voltage for the reversible driver
2	FIN1	I	Input pin for forward control signal for the reversible driver
3	RIN1	I	Input pin for reverse control signal for the reversible driver
4	I _{OUT}	O	Governor load current detector output (open collector*1)
5	V _{ref}	O	Internal reference voltage pin
6	V _{reg}	O	4.6V constant voltage output
7	V _{CC}	I	Power supply (+)
8	OUT1+	O	Reversible driver output (+)
9	OUT1-	O	Reversible driver output (-)
10	OUT2-	O	Governor output (-)
11	OUT2+	O	Governor output (+)
12	FBIN+	I	Governor load current detector amplifier input (+)
13	FBIN-	I	Governor load current detector amplifier input (-)
14	V _{EE}	I	Power supply (-) (connection within substrate)
15	C _{T2}	I	For connection of capacitor for the governor PWM filter
16	RIN2	I	Governor reverse control signal input
17	FIN2	I	Governor forward control signal input
18	V _{IN2}	I	Input pin for setting high output voltage for the governor

*1 Refer to operating notes.

Optical disc ICs

BA6780FP-Y



Pin No.	Pin name	I/O	Function
1	N.C.	—	
2	V _{IN1}	I	Input pin for setting high output voltage for the reversible driver
3	N.C.	—	
4	FIN1	I	Input pin for forward control signal for the reversible driver
5	RIN1	I	Input pin for reverse control signal for the reversible driver
6	Iout	O	Governor load current detector output (open collector*1)
7	Vref	O	Internal reference voltage pin
8	Vreg	O	4.6V constant voltage output
9	V _{CC}	I	Power supply (+)
10	N.C.	—	
11	OUT1+	O	Reversible driver output (+)
12	N.C.	—	
13	OUT1-	O	Reversible driver output (-)
14	OUT2-	O	Governor output (-)
15	N.C.	—	
16	OUT2+	O	Governor output (+)
17	FB IN +	I	Governor load current detector amplifier input (+)
18	FB IN -	I	Governor load current detector amplifier input (-)
19	V _{EE}	I	Power supply (-) (connection within substrate)
20	C _{t2}	I	For connection of capacitor for the governor PWM filter
21	R IN 2	I	Governor reverse control signal input
22	F IN 2	I	Governor forward control signal input
23	N.C.	—	
24	V _{IN2}	I	Input pin for setting high output voltage for the governor
25	N.C.	—	

*1 Refer to operating notes.

Optical disc ICs

●Input / output circuits () : pins for BA6780FP-Y)

Pin function	Equivalent circuit
Logic input	
Voltage setting input	
For connection of capacitor for PWM filter	
Load current detector	

Optical disc ICs

Pin function	Equivalent circuit
Output (reversible driver)	<p>The circuit diagram shows a full-bridge output stage. It consists of four transistors: two NPN transistors at the top and two PNP transistors at the bottom. The top NPN transistors have their emitters connected to V_{CC} and their bases connected to a 10k resistor. The bottom PNP transistors have their emitters connected to V_{EE} and their bases connected to a 10k resistor. The collectors of the top NPN transistors are connected to the anodes of two diodes. The collectors of the bottom PNP transistors are connected to the cathodes of two diodes. The output terminals, labeled pin8, 9 (pin11, 13), are connected to the junctions of the diodes.</p>
Output (governor)	<p>The circuit diagram shows a full-bridge output stage, similar to the one above. It consists of four transistors: two NPN transistors at the top and two PNP transistors at the bottom. The top NPN transistors have their emitters connected to V_{CC} and their bases connected to a 10k resistor. The bottom PNP transistors have their emitters connected to V_{EE} and their bases connected to a 10k resistor. The collectors of the top NPN transistors are connected to the anodes of two diodes. The collectors of the bottom PNP transistors are connected to the cathodes of two diodes. The output terminals, labeled pin10, 11 (pin14, 16), are connected to the junctions of the diodes.</p>
Load current detector signal output (governor)	<p>The circuit diagram shows a load current detector circuit. It consists of a diode connected to pin4 (pin6) and V_{CC}. The other terminal of the diode is connected to a 1k resistor, which is then connected to the base of an NPN transistor. The emitter of the transistor is connected to V_{EE}, and the collector is connected to an output terminal.</p>

Optical disc ICs

●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 10V) (*1 BA6780FP-Y)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I _Q	—	8.0	16.0	mA	Open mode with no load
Mute on voltage	V _{CC1}	—	—	3.5	V	Mute on voltage when V _{CC} falls
Mute off voltage	V _{CC2}	5.5	—	—	V	Mute off voltage when V _{CC} rises
Vref input voltage range	V _{IN}	0	—	4	V	—
Vref pin current	I _{IN}	—	0.02	1.0	μA	—
PWM input high level voltage	V _{IH}	4.0	—	—	V	With V _{CC} as the reference potential
PWM input low level voltage	V _{IL}	—	—	1.0	V	With V _{CC} as the reference potential
PWM input high level current	I _{IH}	—	—	100	μA	—
PWM input low level current	I _{IL}	−1.0	—	1.0	μA	—

<Electronic governor>

Output offset voltage	V _{OF}	−100	0	100	mV	R _L (load)=9Ω, R _O (current detector)=0.6Ω	
Max. pin-to-pin output voltage	V _{OM}	6.0	6.5	—	V	R _L (load)=9Ω, R _O (current detector)=0.6Ω	
Pin-to-pin output voltage 1-1	V _{OUT11}	4.2	4.7	5.2	V	Forward mode	12, 13 open 17, 18pin open *1 R _L (load)=9Ω R _O (current detector)=0.6Ω V _{IN2} =2.5V
Pin-to-pin output voltage 1-2	V _{OUT12}	−5.2	−4.7	−4.2	V	Reverse mode	
Pin-to-pin output voltage 1-3	V _{OUT13}	−100	0	100	mV	Brake mode	
Pin-to-pin output voltage 1-4	V _{OUT14}	−50	0	50	mV	Stop mode	
Voltage gain of positive feedback amplifier	G _{VNF}	20.5	22.0	23.5	dB	V _{ref} =0V, V _{IN} =−20dBV, f=1kHz	

<Reversible driver>

Output saturation voltage	V _{CESAT}	—	1.0	2.1	V	I _O =100mA, V _{IN2} =5V, Total of upper side and lower side ineffective voltage of output Tr	
Pin-to-pin output voltage 2-1	V _{OUT21}	4.5	5.0	5.5	V	Forward mode	I _O =100mA V _{IN1} =2.5V
Pin-to-pin output voltage 2-2	V _{OUT22}	−5.5	−5.0	−4.5	V	Reverse mode	
Pin-to-pin output voltage 2-3	V _{OUT23}	−50	0	50	mV	Brake mode	
Pin-to-pin output voltage 2-4	V _{OUT24}	−50	0	50	mV	Stop mode	
Output load fluctuation	V _{OUT}	—	200	400	mV	Difference in output voltage for I _O =400mA and I _O =100mA	

<4.6V constant-voltage output>

Output voltage	V _{reg}	4.35	4.60	4.85	V	—
Output load fluctuation (source)	V _{OSO}	−20	−5	—	mV	1mA source
Output load fluctuation (sink)	V _{OSI}	—	5	20	mV	1mA sink

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Optical disc ICs

● Measurement circuit

BA6780

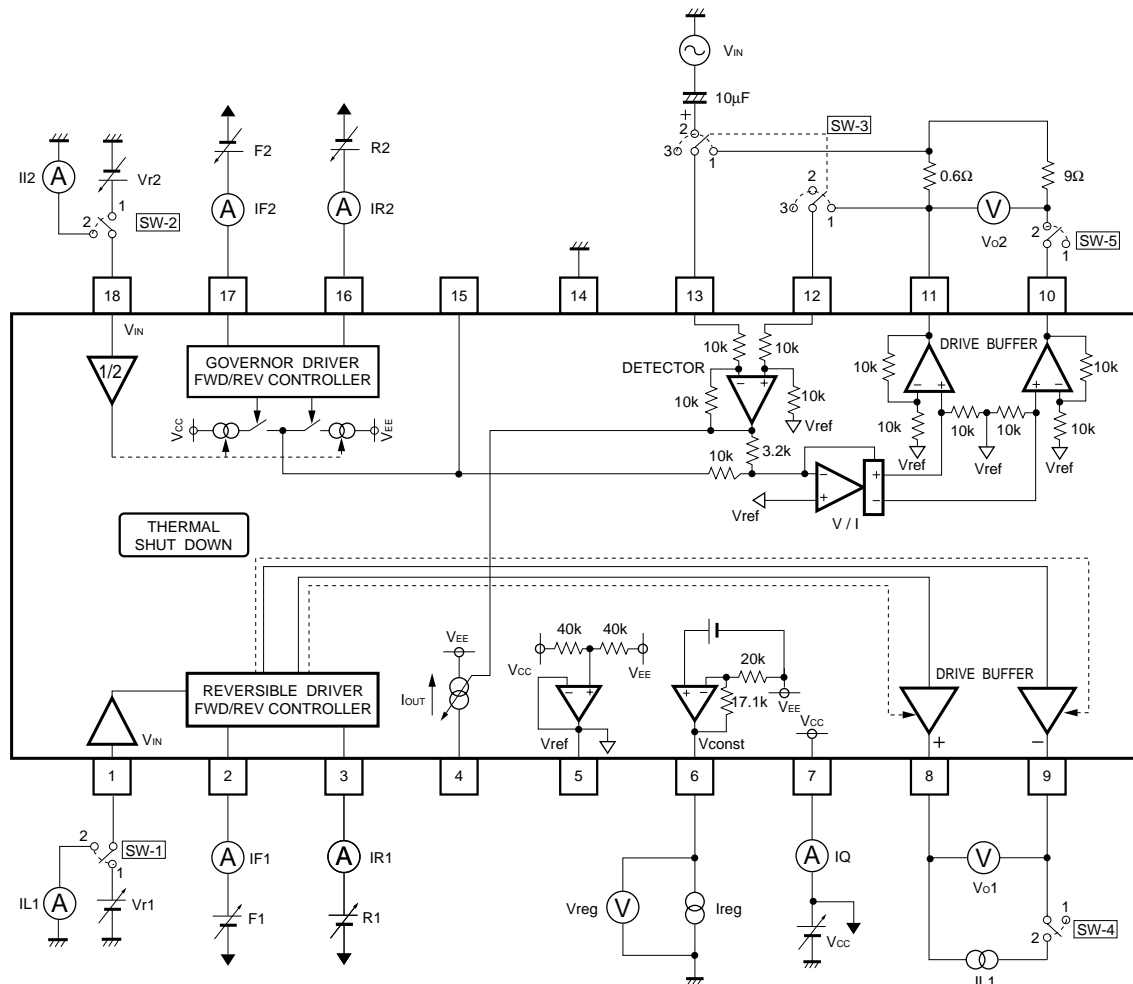


Fig.1

Fig.2

Optical disc ICs

●Measurement circuit switch table

BA6780 / BA6780FP-Y

Parameter	SW					Input								Conditions	Measurement
	SW1	SW2	SW3	SW4	SW5	Vr1	Vr2	F1	R1	F2	R2	V _{IN}	IL1		
Quiescent current	1	1	3	1	1	0	0	0	0	0	0	–	–	–	IQ
Mute on voltage	1	1	3	1	1	2	0	0	5	0	0	–	–	V _{CC} swept down from 10V	Vo1
Mute off voltage	1	1	3	1	1	2	0	0	5	0	0	–	–	V _{CC} swept up from 0V	Vo1
Vref input voltage range	1	1	3	1	2	*1	*1	0	5	0	5	–	–	*1 Check for abnormality in output in Vr1 and Vr2 input range	Vo1 Vo2
Vref pin current	2	2	3	1	1	0	0	0	0	0	0	–	–	–	II1 II2
PWM input high level voltage	1	1	3	1	2	2	2	*2	*2	*2	*2	–	–	*2 Sweep the F/R input, and check that the mode switching is occurring in a range that satisfies the rated values	Vo1
PWM input low level voltage	1	1	3	1	2	2	2	*2	*2	*2	*2	–	–		Vo2
PWM input high level current	1	1	3	1	1	0	0	5	5	5	5	–	–	–	IF1 IF2
PWM input low level current	1	1	3	1	1	0	0	5	5	5	5	–	–	–	IR1 IR2
<Electronic governor>															
Output offset voltage	1	1	1	1	2	0	0	0	0	5	5	–	–	–	Vo2
Max. pin-to-pin output voltage	1	1	3	1	2	0	4	0	0	0	5	5	–	–	Vo2
Pin-to-pin output voltage 1-1	1	1	1	1	2	0	2.5	0	0	0	5	–	–	–	Vo2
Pin-to-pin output voltage 1-2	1	1	1	1	2	0	2.5	0	0	5	0	–	–	–	Vo2
Pin-to-pin output voltage 1-3	1	1	1	1	2	0	2.5	0	0	5	5	–	–	–	Vo2
Pin-to-pin output voltage 1-4	1	1	1	1	2	0	2.5	0	0	0	0	–	–	–	Vo2
Voltage gain of positive feedback amplifier	1	1	2	1	1	0	0	0	0	5	5	*3	–	*3 –20dBV, 1kHz	Vo2
<Reversible driver>															
Output saturation voltage	1	1	1	2	1	5	0	0	5	0	0	–	*4	*4 100mA (take care with polarity)	V _{CC} –Vo1
Pin-to-pin output voltage 2-1	1	1	3	2	1	2.5	0	0	5	0	0	–	*5	*5 100mA (take care with polarity)	Vo1
Pin-to-pin output voltage 2-2	1	1	3	2	1	2.5	0	5	0	0	0	–			
Pin-to-pin output voltage 2-3	1	1	3	1	1	2.5	0	5	5	0	0	–			
Pin-to-pin output voltage 2-4	1	1	3	1	1	2.5	0	0	0	0	0	–			
Output load fluctuation	1	1	3	2	1	2.5	0	0	5	0	0	–	*6	*6 Difference in output voltage for I=400mA and I=100mA	Vo1
<4.6V constant-voltage output>															
Output voltage	1	1	3	1	1	0	0	0	0	0	0	–	–	–	Vreg
Output load fluctuation (source)	1	1	3	1	1	0	0	0	0	0	0	–	–	Source Ireg=1mA	Vreg
Output load fluctuation (sink)	1	1	3	1	1	0	0	0	0	0	0	–	–	Sink Ireg=1mA	Vreg

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●Application example

BA6780

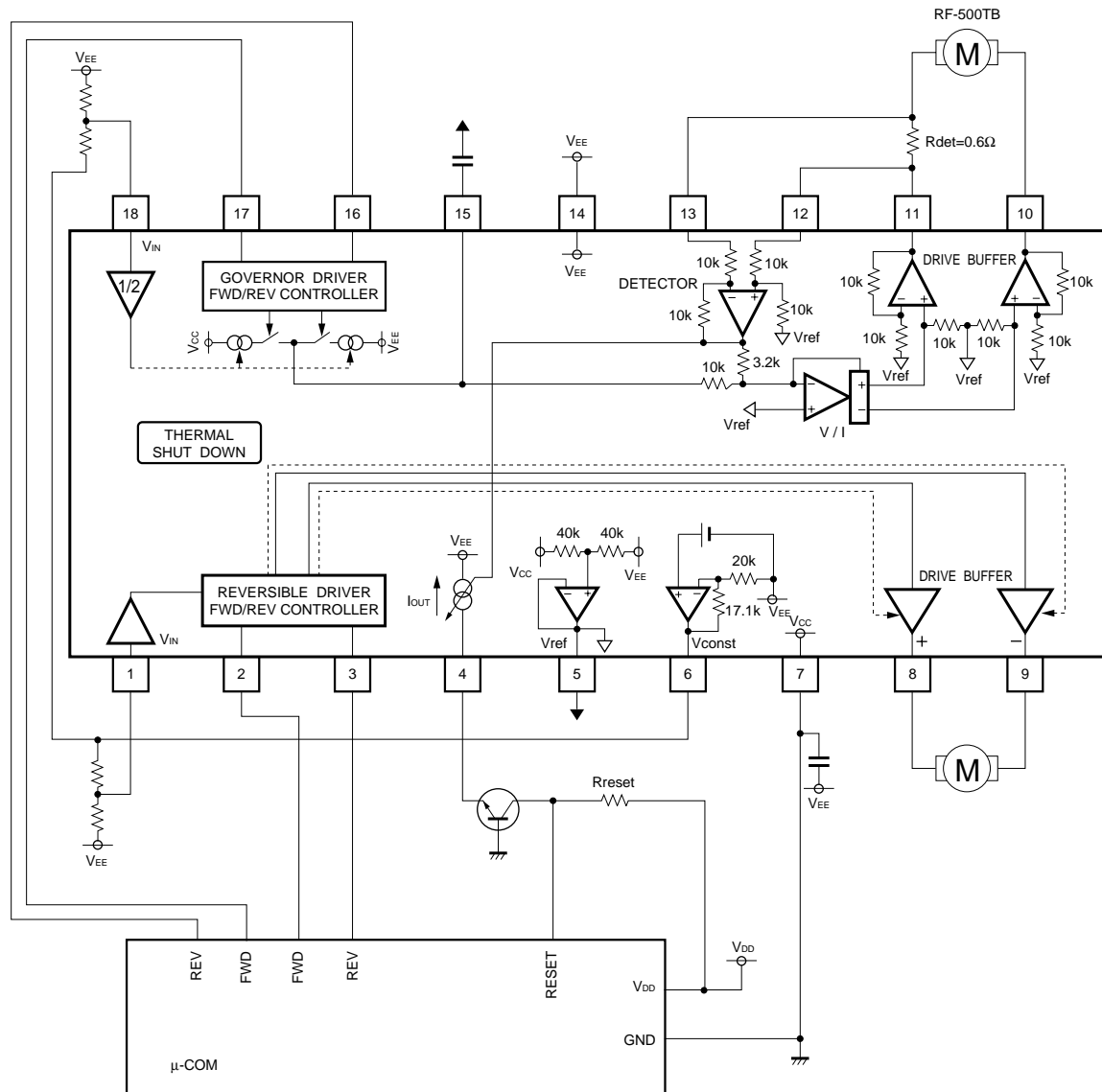


Fig.3

The schematic diagram illustrates the internal circuitry of the RF-500TB Reversible Driver FWD/REV Controller. The circuit is divided into two main functional blocks: the Governor Driver FWD/REV Controller (pins 21-25) and the Reversible Driver FWD/REV Controller (pins 1-6).

Governor Driver FWD/REV Controller (Pins 21-25): This block includes a thermal shutdown protection circuit (THERMAL SHUT DOWN) and a feedback network. It features a voltage divider (10k/10k) connected to V_{IN} (pin 24) and a feedback resistor (10k) connected to pin 21. The feedback signal is processed by a 1/2 gain block. The output of the governor driver is connected to pin 20, which is also connected to the V_{EE} supply.

Reversible Driver FWD/REV Controller (Pins 1-6): This block includes a feedback network and a thermal shutdown protection circuit. It features a voltage divider (10k/10k) connected to V_{IN} (pin 2) and a feedback resistor (10k) connected to pin 1. The feedback signal is processed by a 1/2 gain block. The output of the reversible driver is connected to pin 6, which is also connected to the V_{EE} supply.

Motor Drivers and Feedback: The circuit includes two motor drivers, each with a Drive Buffer. The first motor driver (pins 14-18) is connected to a motor (M) and has a feedback resistor (10k) connected to pin 14. The second motor driver (pins 11-13) is connected to a motor (M) and has a feedback resistor (10k) connected to pin 11. Both motor drivers have a feedback network consisting of a 10k resistor and a 3.2k resistor connected to V_{ref} (pin 19).

Reference Voltages and Biasing: The circuit includes several reference voltages and biasing networks. A V_{ref} network is connected to pins 16 and 17, consisting of a 10k resistor and a 3.2k resistor. A V_{const} network is connected to pins 7 and 8, consisting of a 20k resistor and a 17.1k resistor. A V_{EE} supply is connected to pins 19, 20, and 21.

Microcontroller Interface: The circuit includes a microcontroller interface (μ-COM) with pins REV, FWD, and RESET. The REV pin is connected to pin 25, the FWD pin is connected to pin 24, and the RESET pin is connected to pin 21. The microcontroller also has a V_{DD} supply and a GND connection.

Fig.4

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●Input / output truth table

<Reversible drive>

FIN	RIN	OUT (+)	OUT (-)	Mode
L	H	H	L	Forward mode
H	L	L	H	Reverse mode
H	H	L	L	Brake mode
L	L	OPEN	OPEN	Open mode

<Governor drive>

FIN	RIN	OUT (+)	OUT (-)	Mode
L	H	H	L	Forward mode
H	L	L	H	Reverse mode
H	H	$V_{CC} / 2$	$V_{CC} / 2$	Brake mode
L	L	OPEN	OPEN	Open mode

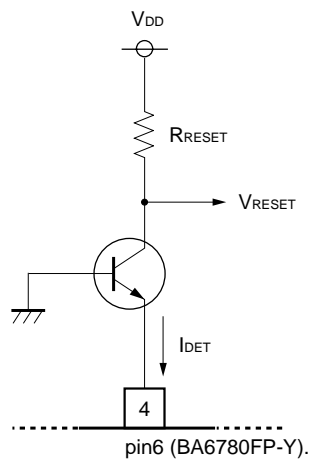
●Using the load current detector output pin (pin 4)

Refer to the example circuit on the right for the connection method. The V_{RESET} value is determined as follows :

$$I_{DET} = \frac{I_O \times R_{DET}}{3.2k\Omega} \quad V_{RESET} = V_{DD} - I_{DET} \times R_{RESET}$$

$$\therefore V_{RESET} = V_{DD} - \frac{I_O \times R_{DET} \times R_{RESET}}{3.2k\Omega}$$

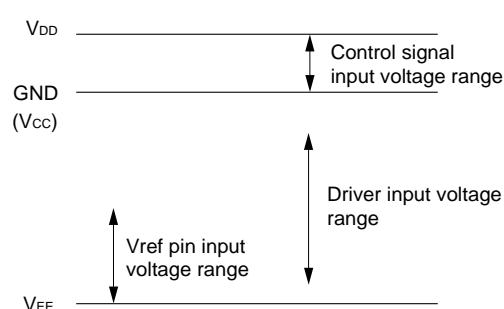
(R_{DET} is the load current detector resistance, refer to the application circuit)



Optical disc ICs

●Operation notes

- (1) The BA6780 and BA6780FP-Y have built in shutdown circuit that mute the output current when the chip temperature reaches 175°C (Typ.). The hysteresis is set to 25°C (Typ.), so the mute will be released when the chip temperature falls to 150°C (Typ.).
- (2) The output current is muted when the supply (V_{CC}) falls to 3V or less. When the mute is applied, the reverse driver is set to the V_{EE} level, and governor driver is set to the $V_{EE} / 2$ level.
- (3) The V_{CC} voltage level is the reference for the logic input pin input voltage, so when it is converted from the V_{EE} potential, the high level becomes $(V_{CC}+5)$ V, and the low level becomes (V_{CC}) V. The voltage potential levels for the pins are shown in the diagram below.
- (4) Connect a bypass capacitor at the base of this IC for the power supply.



●Electrical characteristic curves

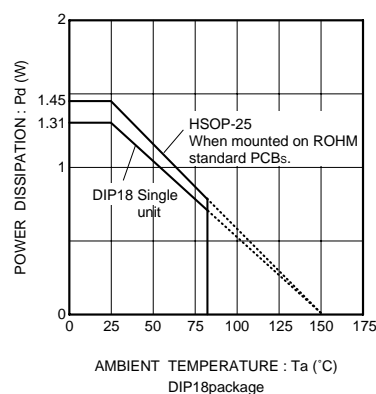


Fig.5 Thermal dissipation curve

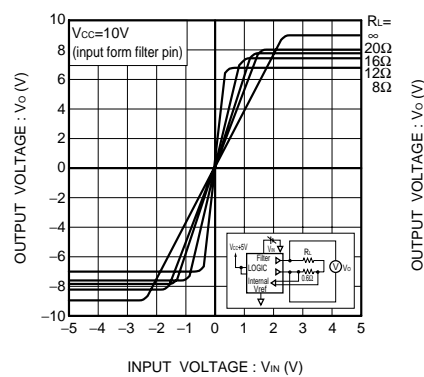


Fig.6 I / O characteristics with governor connected

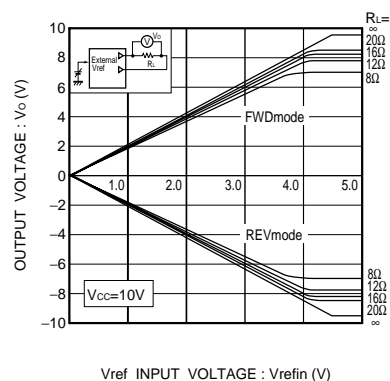


Fig.7 Reversible driver I / O characteristics

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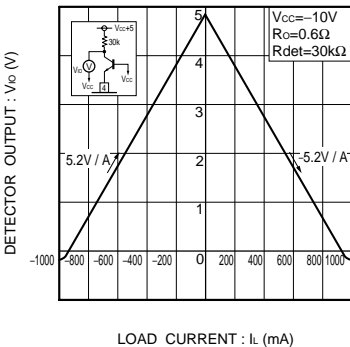


Fig.8 Load current detector output characteristics

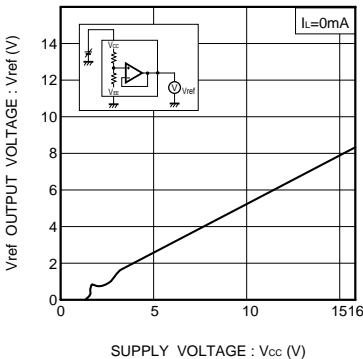


Fig.9 Internal Vref output characteristics

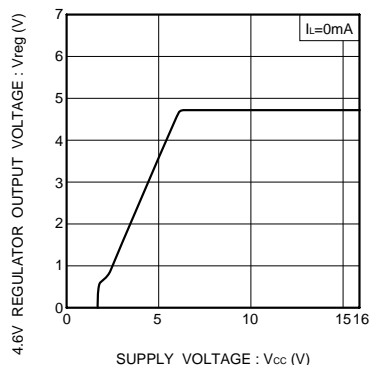


Fig.10 4.6V constant-voltage source output voltage characteristics

●External dimensions (Units : mm)

